Side Impact Air Bag with Head Protection Region

BACKGROUND AND SUMMARY OF THE INVENTION

[0001] The present invention relates to side impact air bags and more particularly to a curtain type of air bag.

[0002] Many vehicles in use today utilize a thin inflatable air bag which, when inflated, is located proximate the sides of the passenger compartment to provide an inflatable barrier, which primarily protects the upper torso and head of the vehicle occupant. These air bags are typically called "curtain" air bags and are typically mounted proximate the roof rail of the vehicle and when deployed, as mentioned above, are located proximate the sides. The length of the air bag will vary with application. Some curtain air bags are only long enough to cover a window while others extend between sets of windows and cover adjacent vehicle support structures such as the A, B, C and/or D pillars of the vehicle.

[0003] The curtain air bag is inflated by a conventional air bag inflator. The inflator is communicated to an inlet of the air bag in a conventional manner.

[0004] The curtain air bag can be constructed utilizing many techniques. For example, two separate panels can be sewn together or the panels joined by an rf weld or similar technique. The air bag can be constructed essentially as a one-piece, integrally woven air bag utilizing a known Jacquard weaving process. Each of the above techniques can be used with the present invention.

[0005] Accordingly the invention comprises: an air bag assembly comprising an air bag including at least a first inflatable region having a plurality of restrictions peripherally located about the inflatable region and configured to restrict the degree of inflation of the air bag proximate the restrictions and configured to permit the first inflatable region of the air bag to achieve its maximum inflatable size in a region interior to the plurality of restrictions. The air bag includes an inner panel and an outer panel configured to form at least the first region. The inner and outer panels are joined together along the plurality of restrictions or joints, each of which extends inwardly from near an edge of the inflatable region, each of the plurality of restrictions or joints configured to reduce

local separation between the inner panel and the outer panel; the plurality of joints configured to permit the inflatable region generally in-board of the plurality of joints to achieve maximum separation between the inner and outer panels.

[0006] Many other objects and purposes of the invention will be clear from the following detailed description of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1 is a plan view showing many of the features of the present invention.

[0008] Figure 2 is an enlarged view of a portion of the air bag shown in Figure 1.

[0009] Figure 3 shows an air bag of the present invention in an inflated state.

[0010] Figure 4 is a cross-sectional view through section 4-4 of Figure 3.

[0011] Figure 5 is a cross-sectional view through section 5-5 of Figure 3.

[0012] Figure 5a illustrates a cross-sectional view through section 5a-5a of Figure 3.

[0013] Figure 6 is a cross-sectional view through section 6-6 of Figure 3.

[0014] Figure 7 is an enlarged view showing the connection of a single inflator to a plurality of bag inlets.

[0015] Figures 8 and 9 show alternate embodiments of the invention.

[0016] Figure 10 shows a folded curtain air bag mounted proximate a roof rail of a vehicle.

DETAILED DESCRIPTION OF THE DRAWINGS

[0017] Figure 1 illustrates part of an air bag assembly 20 according to the present invention. The air bag assembly 20 includes an air bag 30. In the preferred embodiment of the invention, the air bag 30 is manufactured utilizing a Jacquard loom. The benefit of using a Jacquard loom is the air bag 30 is almost fully formed (finished) as it exits the loom with the exception of trimming the border of the air bag and perhaps slitting or opening the inlet or inlets of the bag.

Rather than utilizing the Jacquard loom, the air bag 30 can be constructed by sewing or utilizing rf welding techniques to join two separate panels of material together.

[0018] Figure 1 shows the air bag 30 in an uninflated state, while Figure 3 shows the air bag 30 inflated and situated within a passenger compartment 202 of a vehicle 200 adjacent a side 204 of the vehicle. As can be appreciated, side 204 represents the passenger side of the vehicle. A similarly constructed curtain air bag will also be positioned along an opposing side of the vehicle.

[0019] The air bag 30 includes at least one inflatable region 32 and at least one inlet 35 configured to communicate inflation gas received at the inlet to the inflatable region 32. Region 34, when inflated, is across the front side window 216 of the vehicle (see Figure 4). In one embodiment of the invention, the curtain air bag 30 includes another or second main inflatable region 34. Regions 32 and 34 are positioned on either side of an uninflatable region or area 36. Additional uninflated and inflatable regions can be added to the air bag. In the illustrated embodiment, air bag 30 additionally includes a second inlet 38 in fluid communication with inflatable region 34. The construction and placement of the regions 32, 34 and 36 are more clearly shown in Figure 4, which is a cross-sectional view of the inflated air bag 30. As can be seen, each of the main inflatable regions 32 and 34 is formed by two opposing panels of material 40 and 42. As mentioned above, the air bag 30 is preferably constructed utilizing a one-piece weaving technique utilizing a Jacquard loom. With a Jacquard loom the panels 40 and 42 are automatically formed during the weaving process and include fewer threads than in the joined-together regions of the air bag 30, such as the border regions and the uninflated regions of the air bag. Depending upon the desired permeability through the panels, the air bag can be coated (with urethane, silicone, or other like material) after it is woven or each panel can be coated prior to attachment to each other.

[0020] Reference is again made to Figure 1 and more particularly to the dotted lines 50 and 52. These dotted lines represent the location of sewn seams, which are used to attach separate panels of material 54 and 56 to selected

portions 58 and 60 of the air bag 30. The panels 54 and 56 operate as anchors or tethers to connect these selected portions 50 and 52 of the air bag to cooperating parts of the vehicle 200 as shown in Figures 3 and 4. Fasteners such as 70 and 72, shown diagrammatically in Figure 4, may be used to secure the panels 54 and 56 respectively to parts of the vehicle frame.

[0021] Each triangular tether or anchor panel 54 is sewn along the seam 50 to the air bag 30. The opposite end 55 of panel 54 is secured to the A-pillar 210 of the vehicle. The panel 56 is also triangular in shape and end 57 of panel 56 is secured to the C-pillar 212 of the vehicle. In the illustrated embodiment the end of panel 56 is secured proximate the side 37 of the uninflated region 36. As can be seen in Figure 4, the tether or anchor panel 56 is positioned between that portion of the air bag forming the second inflatable zone 34. When inflated, the anchor panel 56 will be positioned in front of the vehicle window 214 (see Figure 4). In this manner, panel 56 acts as a net or barrier preventing the occupant from being thrown from the vehicle. While not illustrated, the tether panel can also be located at the end of the rear of facing side 64 of the air bag.

[0022] Reference is briefly made to Figure 1 and more particularly to the plurality of tabs 80 formed as part of the upper border 82 of the air bag 30. Each of the tabs 80 includes a central region 84 connected to the upper border 82 as well as two opposing side regions 86. Each of the side regions 86 of each tab 80 is connected to a corresponding center region 84 of the tab 80, however, in the preferred embodiment each lateral region is disconnected from the upper border 82. Each side region 86 of a tab 80 is folded about a corresponding fold line 87 and positioned behind the center portion 84 of the tab 80. In this manner the center portion 84 and the two folded-back side regions 86 form three layers of material increasing the holding strength of the tab 80. Reference is briefly made to Figure 3 showing a plurality of tabs 80 mounted to the roof rail 220 of the vehicle and an individual fastener inserted through the triple thickness of tab material and then secured to the roof rail or mating threadable connector previously inserted in the roof rail. Reference is briefly made to Figure 1 and

more particularly to the rearmost tab 80a. As can be seen, this tab 80a includes the center portion 84 and one lateral tab 86, which is folded rearward about fold line 86 prior to receipt of a fastener such as 90.

[0023] As mentioned above, the air bag 30 includes two inlets 35 and 38 respectively. Reference is briefly made to Figure 7, which illustrates an enlarged portion of the inlet area of air bag 30 and more particularly shows the connection of the two inlets 35 and 38 and inflator 100. The inflator 100 can be any of a known variety of air bag inflators and includes one or more exit ports 102. The exit port or ports 102 are communicated through a connection tube 104 to the inlet 106 of a tee-connector 108. The tee-connector 108 includes outlets 110a and 110b communicated respectively to one of the inlets 35 and 36 of the air bag.

[0024] Reference is again made to Figure 1. At a minimum, the air bag 30 may include one inflatable region 32 or, as illustrated, a plurality of inflatable regions 32 and 34 separated by an uninflated region 36. Part of the regions 32 and 34 is formed in part by borders 46, 46a, 46b and 82, which are integrally formed on the Jacquard loom during the weaving process. Inflatable region 32 includes a plurality of restrictions 120, which extend upwardly from the lower border 46 and which are also formed during the weaving process. In principle each restriction 120 forms a small uninflatable region and is formed in the same manner as region 36. The purpose, however, of the restriction or restrictions 120 is to narrow the distance between the lower portions of panels 40 and 42, narrowing the lower portion of inflatable region 32.

[0025] Inflatable region 32 additionally includes another set of restrictions 124, which extend from a side border 46a (or 46b) and/or upper border 82 and which are generally positioned along the top of the inflatable region 32. The region 32 may include another type of restriction 126, which does not extend to or from the upper border 82 but which connects the panels 40 and 42 in the upper extremes of the inflatable region 32. As can be seen, the restriction 126 is closely positioned to inlet 35 and defines a plurality of flow paths 130 to direct the communication of inflation gas from inlet 35 to the inflatable region 32. In general, the air bag 30 may have the restrictions 120, 124, and 126 expand

generally from a peripheral border. For the purpose of generality, Figure 1 shows additional restrictions 120' extending from the side borders of region 32.

[0026] Reference is briefly made to Figure 2, which illustrates the construction of one of the restrictions 120, 120', 124 and 126. Each restriction includes a stem 140, which extends from a proximate border region such as 46, 48a, 46b and 82 and the restrictions such as 120 include an enlarged region or head 142. In the preferred embodiment the thickness of the stem 140 is approximately 3-5 mm while the head 142 is in the range of approximately 30 mm. The stem includes a radiused or arcuately shaped base portion 144, which extends from the border regions of the air bag. The arcuately shaped base region 144 avoids concentrating forces into a narrow area. As mentioned above, in the preferred embodiment, the air bag 30 is manufactured utilizing a Jacquard loom; consequently the restrictions are also interwoven structures. Alternatively, the restrictions 120, 124, and 126 can be sewn into the air bag, thereby joining the opposing panels 40 and 42 together. If a sewn seam were used, its shape would follow the shape of the stem and head of each restriction shown in Figures 1 and 2. The enlarged head serves as a pressure relieving mechanism to avoid concentrating forces on narrow portions of the air bag, which might damage the air bag as its internal pressure increases.

[0027] As can be seen from Figures 5 and 5a, the greatest separation between the panels 40 and 42 is in a central portion of the inflatable region 32, which by design will correspond to the location of the seated occupant. For example, points 150, 152 and 154 show the impact point of the head of occupants respectively categorized as fifth, 50th and 95th percentile occupants.

[0028] As can be appreciated, the restrictions 120, 124 and 126 also serve to assist in defining the shape of the inflated air bag. If the air bag 30 did not include the peripheral extending restrictions, upon inflation, region 32 would approach the shape of a circular cylinder. Additionally, as the air bag becomes more inflated, the lower edge of the air bag will move upwardly as the region assumes its more circular, inflated shape. This upward movement might

sufficiently displace the air bag so that it does not effectively cushion the occupant.

[0029] As can be seen, most of the restrictions 120, 122 and 124 face the centrally inflated portion 160 of the inflatable region 32. This configuration permits those portions 162 between adjacent restrictions to be filled quickly.

[0030] The rear inflatable region 34 is of similar construction to the forward inflatable region 32. The region 34, as mentioned above, includes a plurality of restrictions such as 120 and 124, a major inflatable region 164 proximate the center of region 34a and a plurality of minor inflatable regions 166 located between adjacent restrictions and borders.

[0031] Reference is briefly made to Figure 1 or Figure 3. As can be seen, inflatable regions 32 and 34 are linked by a common passage 170 located beneath the uninflated region 36 to facilitate the exchange of inflation gas between inflatable regions 32 and 34. The passage 170 is part of a greater chamber 172, situated within portions of the uninflated region to facilitate the flow of inflation gas from any inflatable chamber once reacted upon by an occupant.

[0032] Reference is briefly made to Figure 8, which illustrates an alternate air bag 30a. This air bag also includes two Inflatable chambers 32 and 34 and an uninflatable region 36 as well as a plurality of restrictions extending peripherally into respective inflatable regions. The lateral borders 46a and 46b of air bag 30a are more noticeably curved than in the air bag 30. Air bag 30 shows the use of a single inlet 35, which is communicated to a source of inflation gas (not shown). The uninflated region 36 is configured to form a narrow passage 180, which assists in communicating inflation gas from the inlet to each of the inflatable chambers. Alternatively, a distribution tube 182 (made of metal, plastic or fabric) can be inserted within the inlet and communicated to the inflator (not shown) to distribute the gases to the inflatable regions 32 and 34. The rear inflatable region 34 can be secured to an adjacent vehicle pillar by a panel 56 in the manner described above or by a thin strap or cord 56a.

[0033] Figure 9 shows an air bag 30 with a single inflatable region 32. Region 32 is positioned in front of an adjacent vehicle window 216. The air bag

includes a plurality of tabs 80 to mount the bag near the roof rail of the vehicle. The inflatable region 32 is in part defined by a plurality of restrictions, seams or joints generally shown as numerals 120, 124 and 126. Each of the restrictions 120, 124 and 126 generally extends away from the periphery of the inflatable region 32 and extends toward the center of the inflatable regions 32 in the manner shown in the earlier figures. The restrictions shown in Figure 9 are more bulbous in shape than those shown in Figure 2. The restrictions of Figure 9 include wider and shorter stems 140 and relatively large heads 142. An advantage of this type of restriction, seam or joint 120, 124 and 126 is lower stress.

[0034] Reference is briefly made to Figure 10, which is a cross-sectional view of air bag 30, folded and mounted to the vehicle proximate the roof rail 220. The generally planar air bag 30 has been folded into a number of interlinked accordion pleats 190. Generally, each of the pleats extends from the front end to the rear end of the air bag. After the air bag has been folded it resembles a thin cylinder having a small D/L (folded diameter to length) ratio. For example, the diameter of the folded air bag may be about 38 mm (1.5 inches) to about 76 mm (3 inches). The folded air bag 30 can be placed in a long, thin, tearable, flexible fabric or flexible plastic casing 192. The tabs 80 of the air bag extend through the opening in the casing 192. The casing and folded air bag are protectively enclosed by a clamshell housing 194. The housing 194, the casing 192 and air bag 30 are secured proximate the roof rail 20 by the fasteners 90, each received through a corresponding tab 80. As the air bag 30 inflates with gas it expands, bursting the casing and opening the housing 194. The direction of opening of the housing 194 is shown by arrow 196. The housing 194 pushes away the fascia 198, which normally hides the air bag, permitting the air bag to expand and become situated along a side of the passenger compartment.

[0035] Many changes and modifications in the above-described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, that scope is intended to be limited only by the scope of the appended claims.